

A SEMI-ANNUAL AQUATIC MONITORING REPORT FOR A SURFACE MINE PERMIT (DMLR # 1101760) LOCATED NEAR ROARING FORK IN WISE COUNTY, VIRGINIA

Prepared for: Red River Coal Company, Inc

Authored by:

Chris Isaac

ATS PROJECT NO. 1199.01

September 2012

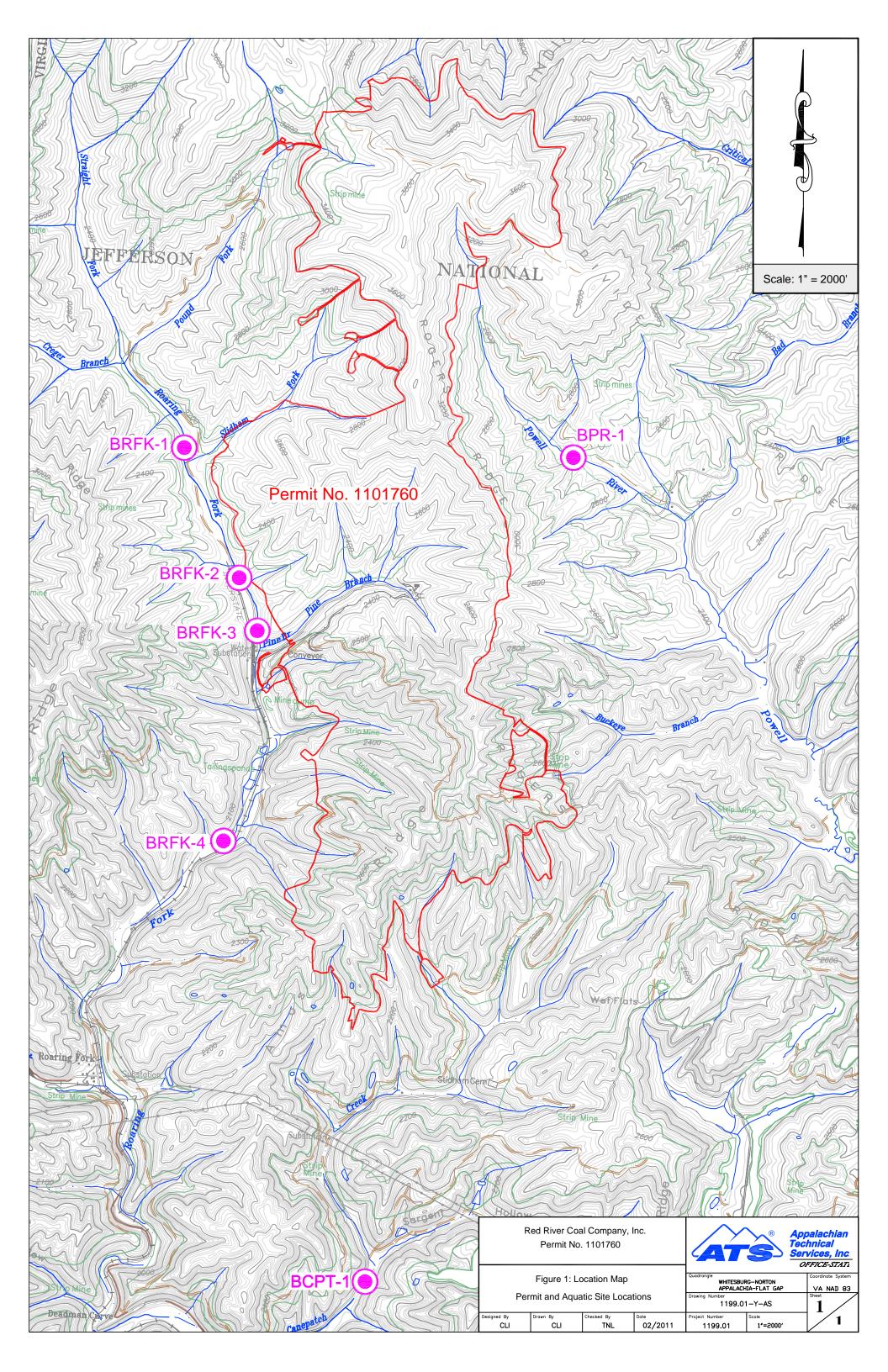
I. INTRODUCTION

Appalachian Technical Services, Inc. was contracted by Red River Coal Company, Inc to conduct ongoing semi-annual (spring and fall) aquatic monitoring at six sites near Roaring Fork in Wise County, Virginia. This report represents the fall 2012 aquatic biological assessments of six sample sites. The permit boundary and sample site locations are shown on the attached topographical map in Figure 1.

II. METHODS

General locations of all sample sites were selected by a Virginia DMLR biologist. However, the exact site locations may have been relocated by ATS senior biologists due to site conditions (*i.e.* low flow, lack of riffle habitat, etc.) and accessibility. Aquatic sampling site BRFK-1 was located on Roaring Fork approximately 50 m upstream of the confluence with Stidham Fork (37.01201; 82.72937). Aquatic sampling site BRFK-2 was located on Roaring Fork approximately 400 m upstream of sample site BFRK-3 (37.00596; 82.72571). Aquatic sampling site BRFK-3 was located on Roaring Fork approximately 50 m upstream of the confluence to Pine Branch (37.00011; 82.72237). Aquatic sampling site BRFK-4 was located southeast of the permit on Roaring Fork approximately 450 m downstream of a series of sediment ponds (39.98557; 82.72422). Aquatic sampling site BCPT-1 was southeast of the permit and located on Canepatch Creek approximately 100 m downstream of the confluence to Sargent Hollow (36.95584; 82.71094). Aquatic sampling site BPR-1 was located to the east of the permit boundary in the upper headwaters of the Powell River approximately 50 m upstream of Red River Coal Company's haulroad (37.01277; 82.69608).

Data collections for the aquatic monitoring consisting of habitat data, macroinvertebrates, grab sample and physiochemical water quality data were collected on 04 September 2012 by ATS Biological Technicians James Breeding and Brian Bledsoe.



A. Habitat Assessments

Rapid Bioassessment Protocol (RBP) high gradient data sheets were used to assess the habitat for each stream. The RBP sheets score each site's habitat based on 10 criteria with 1 - 20 possible points each (for a max total of 200). Based on the 2008 Methods for Assessing Biological Integrity of Surface Waters in Kentucky, Revision 3 (KDOW 2008), stream habitat in the central Appalachians Ecoregion is considered not supporting its designated use if the total score is less than or equal to 116 total points. Habitat must score 117 – 159 to achieve a partially supporting criterion. To qualify as fully supporting habitat, it must score at least 160 total points. Copies of the stream habitat data sheets are attached in Appendix A.

B. Aquatic Macroinvertebrates

Macroinvertebrates were collected using the single habitat approach as described in sections 7.1.1 and 7.3.1 of the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition* (Barbour *et al.* 1999).

Macroinvertebrates were collected by agitating a riffle area of 0.25 meters in front of a standard size (500 Φ m mesh) kicknet. This process was repeated eight times to achieve 2 square meters of sample area. Upon collection, samples from each site were placed in individual containers of 95% ethyl alcohol, labeled, and returned to the lab.

Subsampling procedures followed methods within Appalachian Technical Services, Inc.'s Virginia Department of Environmental Quality approved Quality Assurance Project Plan for Biological Monitoring, 2010 and resulted in the identification of approximately 110 (±10%) individuals. All macroinvertebrates were identified by a North American Benthological Society certified taxonomist to family level with the exception of Chironomidae and Oligochaeta.

Macroinvertebrate metrics were calculated based on the methods included in *A Stream Condition Index for Virginia Non-Coastal Streams* (Tetra Tech, Inc. 2003). ATS

biologists used the Ecological Data Application System (EDAS) to statistically rarify the samples to 110 organisms and calculate VSCI scores. The VSCI is used to compare streams to reference conditions to evaluate a streams current health. A stream must score a 61 or above to qualify as acceptable water quality. In order to calculate the VSCI the following metrics were calculated from the family level aquatic macroinvertebrate data: Taxa richness; Ephemeroptera, Plecoptera, Trichoptera (EPT) Index; Percent Ephemeroptera; Percent Plecoptera + Trichoptera (less Hydropsychidae); Percent Scrapers; Percent Chironomidae; Percent of top two dominant families; and Family Biotic Index (FBI). Tables with the macroinvertebrate data are attached in Appendix B.

C. Physiochemical Water Data

Prior to any field data collections, all handheld meters were calibrated. Four water quality parameters (specific conductance, dissolved oxygen, pH, and temperature) were analyzed using a handheld meter (YSI Pro Plus). Upon return to the lab all meters received a post-calibration check to ensure validity of all measurements recorded.

In addition to handheld meters, a surface water grab sample was collected at each sample site and delivered to Environmental Monitoring Inc. for analysis. Parameters analyzed were Acidity, Alkalinity (Bicarbonate), Alkalinity (Carbonate), Total Alkalinity, Hardness, Total Iron, Total Manganese, Nitrate, Nitrite, Total Cyanide, Total Dissolved Solids, Total Phenols, Total Suspended Solids, Total Boron, Total Magnesium, Total Aluminum, Total Antimony, Total Arsenic, Total Barium, Total Beryllium, Total Cadmium, Total Chromium, Total Cobalt, Total Copper, Total Lead, Total Nickel, Total Selenium, Total Silver, Total Thallium, Total Zinc, Total Mercury, Chloride, Sulfate, and Dissolved Organic Carbon. Grab sample analysis data can be found in Appendix C.

III. RESULTS

A. Habitat Assessments

The stream habitat at BRFK-1 scored 132 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 18 feet wide and characterized mostly by a series of riffles and runs (Figures 2 and 3). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with approximately 25 to 50% of the substrate particles surrounded by fine sediment. The water was clear but there was moderate deposition of sediment within the streambed. The stream banks were moderately stable and with good riparian zones.

The stream habitat at BRFK-2 scored 127 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 18 feet wide and characterized mostly by a series of riffles and runs (Figures 4 and 5). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with 25 to 50% of the substrate particles surrounded by fine sediment. The water was clear but there was moderate deposition of sediment within the streambed. The stream banks were moderately stable but the right bank had a narrow riparian zone.

The stream habitat at BRFK-3 scored 130 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 18 feet wide and characterized mostly by a series of riffles and runs (Figures 6 and 7). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with 25 to 50% of the substrate particles surrounded by fine sediment. The coloration of the water was clear and there was evidence of slight siltation within the streambed. The stream banks were moderately stable but the right bank had a narrow riparian zone.

The stream habitat at BRFK-4 scored 132 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 18 feet wide and characterized mostly by a series of riffles and runs (Figures 8 and 9). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with approximately 25 to 50% of the substrate particles surrounded by fine sediment. The

coloration of the water was clear but there was evidence of moderate sedimentation within the streambed. Both stream banks had suboptimal vegetation and good riparian zones.

The stream habitat at BCPT-1 scored 124 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 12 feet wide and characterized mostly by a series of riffles and runs (Figures 10 and 11). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with 25 to 50% of the substrate particles surrounded by fine sediment. The coloration of the water was clear but there was evidence of moderate sedimentation within the streambed. The stream banks were moderately unstable and with good riparian zones.

The stream habitat at BPR-1 scored 131 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 4 feet wide and characterized mostly by a series of runs and riffles (Figures 12 and 13). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with approximately 25 to 50% of the substrate particles surrounded by fine sediment. The coloration of the water was clear but there was evidence of moderate deposition of sediment within the streambed. The stream banks were unstable but with good riparian areas.

B. Macroinvertebrates

Sample site BPR-1 had the highest Taxa Richness (Tables 1 and 2). Sample site BRFK-1 had the lowest Taxa Richness (Tables 1 and 2). Sample site BPR-1 had the lowest FBI score (3.03), indicating excellent water quality with organic pollution unlikely (Table 2). FBI scores for the six sample sites indicated fairly poor (5.95) to excellent (3.03) water quality (Table 2). VSCI scores for the six aquatic sample sites ranged from a low of 23.61 (BRFK-1) to a high of 55.16 (BPR-1) (Table 2).

coloration of the water was clear but there was evidence of moderate sedimentation within the streambed. Both stream banks had suboptimal vegetation and good riparian zones.

The stream habitat at BCPT-1 scored 124 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 12 feet wide and characterized mostly by a series of riffles and runs (Figures 10 and 11). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with 25 to 50% of the substrate particles surrounded by fine sediment. The coloration of the water was clear but there was evidence of moderate sedimentation within the streambed. The stream banks were moderately unstable and with good riparian zones.

The stream habitat at BPR-1 scored 131 of 200 (Appendix A), indicating the habitat is partially supporting its designated use. The stream was approximately 4 feet wide and characterized mostly by a series of runs and riffles (Figures 12 and 13). Flow occupied >75% of the stream channel. Embeddedness was suboptimal with approximately 25 to 50% of the substrate particles surrounded by fine sediment. The coloration of the water was clear but there was evidence of moderate deposition of sediment within the streambed. The stream banks were unstable but with good riparian areas.

B. Macroinvertebrates

Sample site BPR-1 had the highest Taxa Richness (Tables 1 and 2). Sample site BRFK-1 had the lowest Taxa Richness (Tables 1 and 2). Sample site BPR-1 had the lowest FBI score (3.03), indicating excellent water quality with organic pollution unlikely (Table 2). FBI scores for the six sample sites indicated fairly poor (5.95) to excellent (3.03) water quality (Table 2). VSCI scores for the six aquatic sample sites ranged from a low of 23.61 (BRFK-1) to a high of 55.16 (BPR-1) (Table 2).



Figure 2: BRFK-1 upstream view



Figure 3: BRFK-1 downstream view



Figure 4: BRFK-2 upstream view



Figure 5: BRFK-2 downstream view



Figure 6: BRFK-3 upstream view



Figure 7: BRFK-3 downstream view



Figure 8: BRFK-4 upstream view



Figure 9: BRFK-4 downstream view



Figure 10: BCPT-1 upstream view



Figure 11: BCPT-1 downstream view



Figure 12: BPR-1 upstream view



Figure 13: BPR-1 downstream view

Literature Cited

- Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.
- Kentucky Division of Water (KDOW), 2008. Methods for assessing biological integrity of surface waters in Kentucky, Revision 3. Kentucky Department of Environmental Protection, Division of Water, Frankfort, Kentucky.
- Tetra Tech, Inc. 2003. A Stream Condition Index for Virginia Non-Coastal Streams. Tetra Tech, Inc. Owings Mills, Maryland. Prepared for Virginia Department of Environmental Quality, Richmond, Virginia.

APPENDIX A:

RBP DATA

| | on ID: | 199.01-BPRI | Benthic Wacroinve Ecoregion: | ertebrate Field Data S | neer (front) Land Use Mining |
|--------------------------------|--|--|--|---|---|
| Field | Team: | JEB, BNB | Survey Reason: Bio | monitoring | Start Time: 15:00 |
| Strea | | Bwelli River | Location: 50r | n above road | Finish Time: \S:25 |
| Date: Stre | | 9/4//2 ochemical | Latitude; 37.012 | 77 Longitude: | 82.6960 <u>8</u> |
| Temp | ıment ID numb erature:/ Ived Oxygen: | er: | Conductivity Did instrum | .: 29 :: <u>1140</u> us/cm ent pass all post-calibration o ch parameter(s) failed and ac | checks? YIDPH out = 0. |
| Bent | hic Macro | Invertebrate Colle | ction | | |
| Metho Riffle (| dused (ci | role one) Sir role one) Go | ngle Habitat (Riiile) | Multi Ha Poor None Banks Vegelation | bliat (Logs, plenis, elc) Area Sampled (sq.m.): Zm |
| Current | precipitation flow (circle | circle one) Clou (circle one) Cloar | Market Control of the | Above Normal Floo | Officer d |
| | FEATUR | EŚ: | Predominant Surroundin | | |
| | Stream Wi Range of I Average V Discharge Est, Reach | Depth // O ft fl/s cfs | Surface Mining Deep Mining Oil Wells O Land Disposal | 0 Construction 0 Commercial 0 Industrial 0 Row Crops | ₱ Forest ⊕ Pasture/Grazing ⊕ Silviculture ⊕ Urban Runoff/Storm Sewers |
| | θ Island θ Other_ | θ Bridge Abutments θ Waterfalls | 0 High | 9 Very Rapid or Torrential | θ Ephemeral θ Seep |
| | 0 Grasses | ype: Holar Shrubs Bucke Dilerbaceous Willow | γ© Θ Partially Θ Partially | naded (75-100%) | nel Alterations: dging muelization OPartial) |
| | Dominate 1 Prices Orasses Number of | ype; Poplar Shrubs Bucke OHerbaceous Willow strata 3 | © Fully SI ∀ ⊕ Partially ⇔ ⊕ Partially ⊕ Pully Ex | nded (75-100%) | dging muelization |
| 1. Epifat Substrat Gover | Dominate 1 Trees Grasses Grasses Number of Substrate 6 | ype; Holas Shrubs Bucke. Diferbnceous Willo Strata 3 Est. OP.C. Optimal Greater then 70% of substanceous favorable for epifauna colonization and fish cover mix of snags, submerged logs, unidercut banks, cobt or offer stable habitet and stags to alloys full colonization for allogs of the stage of the s | Partially Partially Partially Prully Ex Riffle Pow Riffle Ri | naded (75-100%) # Dre Shaded (50-75%) # Cha Exposed (25-50%) # GFull posed (0-25%) Run Z | dging muelization OPartial) |
| Substrai Gover | Dominate file Trees 9 Grasses Number of Substrate 6 unal | ype; Shrubs Strata Strata Optimal Greater then 70% of subsite favorable for epitauna colonization and fish cover mix of snags, submerged logs, unidercut banks, cobit or other stable habitet and stags to attoy full colonizat potential (i.e. logs/snags ti are not new fall and not transsent). 20 19 18 17 16 Optimal Gravel, cobble, and houlder particles are 0-25% surrounded by fine sediment. Layering of cobble provides | O Fully Sign of Partially O Pully Ex Riffle | naded (75-100%) 0 Dre Shaded (50-75%) 0 Cha Exposed (25-50%) (0Full posed (0-25%) Run ZS % bitat Data Sheet Marginal bitat; 20-40% mix of stable habitat; habitat avallability less than desirable; sbustrate frequently disturbed or removed. aw for ight 10 9 8 7 6 Marginal Gravel, cobble, and boulder particles are 50- | dging nnelization OPartial) Pool 5 % Poor Less (han 20% stable habitat, lack of habitat is obvious; substrate |
| Substrai Gover | Dominate 1 Trees 9 Grasses Number of Substrate 6 unal te/Available SCORI | ype; Shrubs Schrubs Schrubs Schrubs Schrubs Schrubs Schrubs Schrubs Schrubs Optimal Grealer then 70% of subshfavorablo for epifauna colonization and fish cover mix of snags, submerged logs, undercut banks, cobble or other stable habitet and stags to allow full colonizat potential (i.e. logs/snags ti are not new fall and not transsent).r 20 19 18 17 16 Optimal Gravel, cobble, and houlder particles are 0- 25% surrounded by fine sediment, Layering of cobble provides diversity of niche space, | O Fully Sign O Fully Sign O Fully Sign O Partially O Partially OF ully Extended for full of the substant of stable has well suited for full of the substant of population substant on the form of a fall, but not yet prepared colinzation (may rate at hier of scale). 15 14 13 12 11 Suboptimel Gravel, cobble, and boulder particles are 2 50% surrounded by fin sediment. | inded (75-100%) # Dre Shaded (50-75%) # Cha Exposed (25-50%) # (9Full posed (0-25%) Run ZS % bitat Data Sheet Marginal bilat; 20-40% mix of stable habitat; habitat availability less than destrable; sbustrate frequently disturbed or removed. aw for light 10 9 8 7 6 Marginal Gravel, cobble, and boulder particles are 50- 8 5 5 surrounded by fine sediment. 10 9 8 7 6 Marginal Only 2 of the 4 habitat regimes present (if fast- | dging multisation Partial) Pool 5 % Poor Less than 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking. 5 4 3 2 1 Poor Gravel, cobbie, and boulder partices are more thatn 75% surrounded by fine |

| '4. Sediment Deposition SCO | Optimal Little or no enlargeme of Islands or point ba and less than 5% (<20 for I; ow-gradient streams) of the botton affected by sediment deposition. | bar formation, mostly from gravel, sand or fine sediment. 5-30% (| new gravel, sand or fi sediment on bld and 20- new bars; 30-50% (50- | ne material, increased bar development; more than 50% (80% for low- |
|---|--|---|---|---|
| | 20 19 18 17 16 | | 10 9 8 7 6 | 5 4 3 2 1 |
| 5, Channel Flow Status | m/s. Optimal Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Suboptimal | Marginal Water fills 25-75% of the available channel, and for riffle substrates are mostly exposed. | channel and mostly |
| 6. Channel Alteration | | Suboptimal Some channelization present, usually in area of bridge abutements; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present. | Marginal Channelization may be | Poor Banks shored with s gablon or cement over 80% of the stream reach |
| SGOR 7. Frequency of Riffle (or bends) | | | Marginal Occasional rifile or bend; bottom contours provide saome habital; distance btw. rifiles divided by the width of the stream is btw. 15 to | Foor Generally all flat water or shallow riffles; poor habitat; distance btw. riffles dividied by the width of the stream is a ration of >25%. |
| SCORE 8. Bank Stability (score each bank) | 20 19 18 17 16 Optimal Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected. | Suboptimal Suboptimal Moderately stable; Infrequent, small areas of crosion mostly healed over, 5-30% of bank in reach has areas of crosion. | 10 9 8 7 6 Marginal Moderately unstable, 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | 5 4 3 2 1 Poor Unslable; many eroded areas "raw" areas |
| | 10 9 Optimal More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including frees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow | 8 7 G Suboptimal 70-90% of stream bank surfaces covered by native vegelation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent more than | less then one-half of the | 2 1 0 Poor Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 cm or less in average stubble height. |
| 900DE DB - | naturally. | 6 7 6 ! | i 4 3 | 2 1 0 |

SCORE RB 10 SCORELB 10 9

SCORE RB 10

SCORE LB 10

Vegetative Zone Wicith Width of ripadan zone

10. Riparian

(score each bank)

9

9

>18 m; human activities

(l.e. parking lots, roadbaeds, clear-cuts, lawns, or crops) have

not impacted zone.

Optimal

8 7 6 ® 7 6

607

8)7 б

Suboplimal

only minimally.

6

Width of riparian zone

have impacted zone

5 4 3 4

5 4 3

12-18 m; human activites 6-12 m; human activite id

5 4 3

Marginal

great deal.

Width of riparian zone

have impacted zone a

2 1 2 1 0

2 1 0

2 1 Q

Poor

Width if riparian zone

riparian vegetation due

to human activities.

<6 m; Iltila or no

SCORE

131

| Station ID: | /199.01-BRFK1 | Benthic Wacroinve Ecoregion: | ertebrate Field Data | Sheet (front) Land Use Mining | |
|--|--|--|--|--|-------|
| Fleld Team: | JEB, BWB | Survey Reason: 1370 | . Monitorina | Start Time: 14:00 J | |
| Stream Name: | Roaring Forts | Location: Asia | ont to rail road | Finish Time: 14:36 | |
| _{Date:} Stream Physi | 9/4/12 cochemical | Latitude: 37.012 | Ol Longitude; | 82.72.937 | |
| Instrument ID num Temperature: Dissolved Oxygen: | 18.1 Ca | Gonductivity Did Instrum | 8.25 : 1338 us/cm ent pass all post-calibration ch parameter(s) falled and c | | = 0.3 |
| Benthle Macre | Invertebrate Colle | ction | | | |
| Method used (d | The state of the s | gle Hablfat (Rille) od Marginal | Multi H Poor None Banks Vegelation | Aron Campled (or m) | 7m² |
| Recent precipitation Stream flow (circle INSTRE, FEATUR Stream W | (clicle one) Glou (clicle one) Glour e one) Low AME WATERSHED ES: idth 12 ft Depth 1.5 ft Celocity ft/s cfs | water- | | Other od #Forest #Project #Projec | |
| 0 Island 0 Other Riparian V Dominate T 0 Trees 0 Grasses | Type: Redoclarde OShribs Magnotia OHerbaceous Birch | Shrub Taxa Canopy Co Fully Sh O Partially O Partially | aded (75-100%) | nal Perennial © Intermittent 9 Ephemeral 9 Seep Incl Alterations; edging annelization Il 6Partial) | |
| Number of Substrate 9 | 1,000,000 | Rime 40 % | Run 55 % | Paol 5 % | |
| 1. Epifáunál Súbstrate/Avallable Gover | Optimal Greater then 70% of substrations of substration and fish cover mix of snags, submerged logs, undersubtation and a stage to allow full colonization. | HighGradient Hab Suboptimat ate 40-70% mis of stable hab well suited for full colonization patential; adequate habitat for maintenance of population | Itat Data Sheet Marginal Itat; 20-40% mix of stable habitat; habitat evallabitity less than destrable; sbustrate of requently disturbed of removed. | Poor Less (han 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking. | |
| 2. Embeddedness | Optimal Optimal Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space, 20 19 18 17 16 | Suboptimel Gravel, cobble, and boulder particles are 25 50% surrounded by fine sediment. | | Foor Poor Gravel, cobbie, and boulder partites are more that n 75% surrounded by fine sediment. | |
| Velocity/Deptin egime | Optimal CoverAll four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3 m/s, deep is >0.5 | Suboptimal Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Marginal Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low). | Poor Dominated by 1 veoletlyldepth regime (usually slow-deep). | |

| 4. Sediment Deposition | Optimal Littie or no enlarge | Suboptima ement Some new incr | | Poor sillon of Heavy deposits of fine |
|--|---|--|--|---|
| | of Islands or point and less than 5% for I; ov-gradient streams) of the bot affected by sed ime | bars bar formation, i from gravel, sai fine sediment. E tom 50% for low-gra the bottom affer | nostly new gravel, sar id or sediment on bl -30% (20- new bars; 30-50 dlent) of 80% for low-gra ted; | nd or fine material, increased bard development; more that \$50% (80% for low- |
| Si Si | deposition. CORE | slight deposition | 1 ln | pools almost absent. |
| | 20 19 18 17 m/s. | 16 15 14 13 1 | 발표를 들어가 된 경기를 즐 | 6 5 4 3 2 1 |
| 5, Channel Flow Status | Optimal Water reaches hase both lower banks, a minimal amount of channel substrate is exposed. | nd available channe 25% of channel | l; or available channe and/or riffle subs | i, channel and mostly drates present as slanding |
| | ORE 20 19 18 17 1 | Name / | | 6 5 4 3 2 1 |
| 6. Channel Allerat | Channelization or dredging absent or minimal; stream with normal patter. | evidence of past channelization, t.e dredging, (greater past 20 yr.) may b present, but recen channelization is r present. | enters extensive; emban or shoring struct present on both b and 40 - 80% of st than reach channelized disrupted. | kments gabion or cement over ures 80% of the skeem reach anks; channelized and clarified. Instream and habitat greatly altered or removed entirely. |
| 7. Frequency of Rif | | 15 (14) 13 12 Suboptimal | 11 10 9 8 7 G Margīnal | 5 4 3 2 1 Poor |
| (or bends) | Occurrence of riffles relatively frequent raff of distance bitw. riffled divided by width of the stream 47:11 generally to 7); variety of habitat if key. In streams when riffles are continuous, placement of boulders or other large, natural obstruction is important. | btw. riffies divided the width of the stra 5 Is btw. 7 to 15, s e | bend; bollom conto by provide saome hab | ours or shallow riffles; poor (lat; habitat; distance blw. riffles dividied by tho n of width of the stream is a |
| SCOF 8. Bank Stability | RÉ 20 19 18 17 16 | 15 14 13 (2) 1 | | 5 4 3 2 1 |
| (score each bank) | Optimal Banks stable; evidence of eroston or bank failure absent or minimal; liftle potential for future problems. < 5% of bank affected. | Suboptimal Moderately stable; Infrequent, small are of erosion mostly frealed over, 5-30% o bank in reach has are of erosion. | has areas of erosion; f high erosion potentia | areas "raw" areas |
| SCORE RE | 3 10 9 | 8 ① G | 5 4 3 | 2 1 0 |
| SCORE LE 9. Vegetative Protection (score each bank) | Oplimal | Suboptimal 70-90% of stream ban surfaces covered by native vegetation, but not well-represented; disruption evident but not affecting full plant growth potential to any one-half of the potential plant stubble helght remaining. | bank surfaces covered by vegetation; disruption; obvious; patches of bare soll or closely cropped vegetation common; less then one half of th potential plant stubble | covered by vegetation; disruption of stream bank vegetation is very high, vegetation has been removed to 5 cm e of less in average |
| | 10 9 | 8 D 6 | 5 4 3 | 2 1 0 |
| SCORE LB 10. Riparian | Oplimal | B 7 6 Suboptimal | 5 4 3 Marginal | 2 1 0 Poor |
| /egetative Zone Width (score each bank) | Width of riparian zone >18 m; human activities i.e. parking lots, | Width of riparian zone | Width of riparian zone s 6-12 m; human activiteic have impacted zone a great deal, | Width if riparian zone |
| SCORERB 1 SCORELB 1 | Section 1 | | 5 4 3 5 4 3 | 2 1 0 2 1 0 SCO |

| Station ID: | 1199 OI-BREKZ | Benthic Macroin | vertebrate Field Data | Sheet (front) Land Use Minimon |
|--|--|--|--|---|
| Fleld Team: | JEB, BWB | | o monitoring | Start Time: 13:10 |
| Stream Name: | Roaring Fork | Location: A | ljacent to haul | Finish Time::_ |
| _{Date:} Stream Phys | 9/4//2 icochemical | The second secon | 596 Longitude: | 82.72.57/ |
| Instrument ID num Temperature: Dissolved Oxygen | 20 0 Ca | Conductly Did Instru | 8.40 lly: 1388_uS/cm nent pass all post-calibration olch parameter(s) falled and | ichecks? YND PHENT = 0 |
| Method tised (| circia one) G | ection ingle Habitat (Rivie) ood Marginal lifte Snags | Multi F Poor None Banks Vegelation | [[살아이 아이에 발표되는 소설 보다] |
| INSTRI FEATU | (circle one) Gloa (circle one) Gloa de ono) Low AM WATERSHED RES: | Control of the Contro | ed featurees; | Officer od |
| Stream V Range of Average Discharg Est. Reac | Depth 1.0 ft Velocity fl/s cfs | Surface Mining | O Construction O Commercial Industrial O Row Crops | © Forest 0 Paştüre/Grazing 0 Silvicultüre 0 Urbañ Runoff/Storm Sewers |
| Ø Island Ø Other Riparian Dominate Trees Grasses | Typo: Roplar Shrubs Sycam Hernbaceous Hernbaceous | ore O Partial O Partial | Shaded (75-100%) 0 D ly Shaded (50-75%) 0 Cl | mal Percennial © Intermittent O Ephemeral O Seep nnel Alterations; edging nannelization Il OPartial) |
| | OEst. OP.C. | Riffie 55 % | Run_ 45% | Pool |
| , Epifáunál ubstrate/Avallable over | fayorable for epifatina colonization and fish cove mix of snags, submerged logs, undercut banks, cob or other stable habitat and | HighGradient Hi Suboptimat Irale 40-70% mis of stable h veil suited for full ri colonization petential; adequate habitat for maintenance of propulat at presence of additional tion substrate in the form of | abliat Data Sheet Marginal abitat; 20-40% mix of stable habitat; habitat; habitat availability less than clestrable; spustrate frequently disturbed of removed. | Poor Less (hah 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking. |
| Embeddedness | E 20 19 18 17 16 Optimal Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversily of niche space 20 19 18 17 16 | sediment. | Marginal Gravel, cobble, and 25- boulder particles are 50- | Foor Gravel, cobble, and boulder partites are more that in 75% surrounded by fine sediment. |
| relocity/Deptin Jime | Optimal CoverAll four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is | Suboptimal Only 3 of the 4 regime present (if fast-shallow is missing, score lowe | Marginal s Only 2 of the 4 habitat regimes present (if fast- | Poor Dominated by 1 veoletly/depth regime (usually slow-deep). |

| '4. Sediment Deposition SC | Optimal Little or no enlarge of Islands or point and less than 5% (for I;ov-gradient streams) of the bot affected by sedime deposition. | t bars bar formation, m (<20% from gravel, saic fine sediment. 5- tiom 50% for low-grad the bollom affect slight deposition pools. | ostly new lor sed 10% (20- new ent) of 80% ed; n | Marginal erate deposition e gravel, sand or fi ment on old and bars; 30-50% (50- for low-gradient) | material, increased bar development; more than 50% (80% for low- of gradient) of the bottom changing frequently; pools almost absent. |
|---|---|---|---|--|--|
| | 20 19 18 17 m/s. | 16 15 14 13 12 | 11 10 | 9 8 7 6 | 5 4 3 2 1 |
| 5, Channel Flow Status | Optimal Water reaches base both lower banks, a minimal amount of channel substrate is exposed. | nd available channel; 25% of channel substrate is expos | f the Water or avalla and/or | Marginal fills 25-75% of th blo channel, rriffle substrates ostly exposed. | Poor' e Very little water in channel and mostly present as slanding pools. |
| SCC 6. Channel Alteration | ORE 20 19 18 17 1 | | | 8 7 6 | 5 4 3 2 1 |
| o, Channel Alteration | on Optimal Channelization or dredging absent or minimal; stream with normal pat(er. | Suboplimal Somo channelizatic present, usually in of bridge abutemer evidence of past channelization, i.e., dredging, (greater ti past 20 yr.) may be present, but recent channelization is no present. | on Chann areas extens nts; or sho presen and 40 nan reach c disrupt | ring structures t on both banks; -80% of stroam hannelized and | Poor Banks shored with Banks shored with S gablon or cement over 80% of the stream reach channelized and disrupted, instream habitat greally altered or removed enlirely. |
| SCOI | RE 20 19 18 17 16 | 15 14 13 12 (1 | 10 9 | 8 7 6 | 5 4 3 2 1 |
| 7. Frequency of Rifff (or bends) | | Suboptimal Occurrence of riffles o infrequent; distance that riffles divided by the width of the strea 5 is blw. 7 to 15. | Ma Occasio bend; bo provide in distance divided l | rginal nal riffle or Illom contours acome habital; btw. riffles ry the width of m is blw. 15 to | Poor Generally all flat water or shallow tiffles; poor habitat; distance blw. riffles dividied by the width of the stream is a ration of >25%. |
| SCORI | E 20 19 18 17 16 | 15 14 13 (12) 11 | 10 9 8 | 7 6 | 5 4 3 2 1 |
| 8. Bànk Stability (score each bank) | Optimal Banks stable; evidence of croston or bank failure absent or minimal; little potential for future problems. < 5% of bank affected. | Suboptimal | Marg Moderatel 60% of ba has areas high erosi | ingl y unstable, 30- nk in reach of erosion; on potential | Poor Unstable; many eroded areas "raw" areas |
| SCORERB | | 8 7 G | 6 4 3 | 2 | 1 0 |
| SCORE LB 9. Vegetative | | 8 D 6 | 5 4 3 | | 1 0 |
| Protection (score each bank) | stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory strubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | Suboptimal 70-90% of stream bank surfaces covered by native vegolation, but one class of plaints is not well-represented; disruption of ident but not affecting full plaint growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | Marginal 50.70% of (bank surfac by vegetatin disruption o patches of i closely crop vegetation or tess then or potential pli helght rema | he stream L. es covered stream; com; composite stream; composite stream; common; commo | oor ess than 50% of the fream bank surfaces by vegetation; sruption of stream ank vegetation is very gh; vegetation has en removed to 5 cm less in average Job Je height. |
| SCORE RB 1 | | ® 7 6 | 5 4 3 | 2 | 1 0 |
| /egetative Zone Width W (scoré each bank) > (i. ro Ia | Plimal Adth of riparian zone 18 m; human aclivities è, parking lots, | To 6 Supoptimal Width of riparian zone 12-18 m; human activites have impacted zone only minimally. | 5 4 3 Marginal Width of ripar 6-12 m; huma have impacte great deal. | n activiteid <6 i d zone a ripa | 1 0 or Ilh If riparian zone n; Illila or no rian vegetation due uman activilles. |
| SCORE RB 10 SCORE LB 10 | | | ⑤ 4 3 5 4 3 | | 1 0 1 0 SCORE |

127

| Station ID: | 1199 OI-BRFK3 | Benthic Macroinve | rtebrate Field Data S | Sheef (front) Land Use Mining | N . |
|--|--|--|--|--|---------------|
| Fleid Team: | JEB, BWB | Survey Reason: Bio. | Monitoring | Start Time: \(\mathbb{Z}:2\) | 9 |
| Stream Name: | Roaring Forts | | ent to old coke | Finish Time: 12:50 | |
| _{Date:} Stream Physi | 9/4//2 cochemical | Latitude: 37.000 | | 82.72237 | |
| Dissolved Oxygen: | 19.3 Ca <u>8.88 mg/l</u> | Conductivity: Did Instrume If NO - which | 45us/cm nt pass all post-calibration n parameter(s) falled and a | checks? Y/\(\overline{\ove | <u>= 0.38</u> |
| Method used (c | rola one) Ga | ction igle Habitat (Rivie) out Marginal ifle Snags | Multi H Poor None Banks Vegelation | ibliat (Logs, planis, elc) Area SampTed (sq. m.): | <u>In</u> 2 |
| Recent precipitation Stream flow (circl | (clicle one) Cloi (clicle one) Clear e one) Low AMI WATERSHED ES: | Showers | Above Normal Floo FEATURECS: | Officer aid | |
| Stream W Range of Average \ Discharge Est, Reach | Depth 1 0 ft Velocity ft/s | Predominant Surrounding Surface Mining Deep Mining Oil Wells Heand Disposal | 9 Construction 9 Construction 9 Commercial 9 Industrial 9 Row Crops | © Forest & Pasture/Grazing & Silviculture & Urban Runoff/Storm Sew | ·c13 |
| 0 Island 0 Other Riparian V Dominate 6 Trees | 9 Bridge Abutments 9 Waterfalls egetation: Dom. Tree Type: Sycamore 9 Shrubs 9 Herbaceous | ## High ### ################################ | Prooled θ Low | Stream Type: Perennial 0 Intermittent 0 Ephemeral 0 Seep nel Alterations: defing annelization 1 0 Partial) | |
| Substrate 6 | Est. 0P.C. | Rime_ <u>80</u> % | Run 20 % | Pool 0 % | **** |
| 1. Eplfaunaf Súbstrate/Avallable Cover | favorable for epifatina colonization and fish cover mix of snags, submerged logs, undercut banks, cobb or other stable habitat and stage to allow full colonizat potential fie. Jogs/snags in are not new fall and not fransent).r | adequate habital for le maintenance of populations at presence of additional ion substrate in the form of nev | Marginal at; 20-40% mix of stable habitat; inabitat evallability less than destrable; sbustrate frequently disturbed or removed. | Poor Less (lian 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking. | |
| 2. Embeddedness | Optimal Gravel, cobble, and houlder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space, 20 19 18 17 16 | 15 (14) 13 12 11 Suboptimal Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment. | 75% surrounded by fine sediment. | Poor Gravel, cobble, and boulder partites are more that n 75% surrounded by fine sediment. | |
| 3. Vėlocity/Depth Regime | Optimal CoverAll four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3 m/s, deep is >0.5 | Suboptimal Only 3 of the 4 regimes present (if fast-shallow is missting, score lower than if missing other regimes). | 10 9 8 7 6 Marginal Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low). | Poor Dominated by 1 veolcity/depth regime (usually slow-deep). | |

| '4. Sediment Deposition | Optimal Little or no enlarg of Islands or poir | nt bars bar formation, r | easó in Moderate de nostly new gravel, | position of sand or fine | Poor Heavy deposits of line material, increased ba |
|--|--|---|---|--|---|
| | and less than 5% for I;oy-gradient streams) of the bo affected by sedim | fine sediment. 5 50% for low-gra | d or sediment or -30% (20- new bars; 30 dent) of 80% for low- | i old and -50% (50 - gradient) of | development; more tha 50% (80% for low- gradient) of the bottom changing frequently; |
| 5 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1) | depositión. | slight deposition pools. | | | oools almost absent |
| | 20 19 18 17 m/s. | 16 15 14 13 1 | 2 1 10 9 8 | 7 G | 5 4 3 2 1 |
| 5, Channel Flow Status | both lower banks, minimal amount of channel substrate i exposed. | and available channe 25% of channel Is substrate is expo | l; or avallable char and/or riffle si | 75% of the V inel, c ibstrates p | Poor Yery little water in hannel and mostly resent as standing ools. |
| SC 6. Channel Allera | CORE 20 19 18 17 · Hon Optimal | 16 (15) 14 13 12 Suboplimal | 11 10 9 8 7 Marginal | 6 5 | 4 3 2 1 Poor |
| | Channelization or dredging absent or minimal; siream wit normal patier. | Some channelizat present, usually h | lon Channelization 1 areas extensive; emb ents; or shoring stri present on boll and 40 - 80% of than reach channelia disrupted. | ankments ga ictures 80 i banks; ch stroam dis ied and ha | anks shored with ablon or cement over % of the streem reach arnelized and stripled. Instream bitat greatly altered or moved onlirely. |
| | DRE 20 19 18 17 16 | 5 15 14 13 12 | 10 9 8 7 | 6 5 | 4 3 2 1 |
| 7. Frequency of Rif (or bends) | Occurrence of riffes relatively frequent rate of distance blw. riffled divided by width of the stream <7.1 generally to 7); variety of habita if key. In streams when tilles are continuous | d btw.rlftjesdivided.l the width of the stre y 5 Is blw. 7 to 15, its | bend; bollom co by provide saome h | ntours or s abital; hab les riffle dth of widt | Poor nerally all flat water hallow riffles; poor Itat; distance btw. as dividied by tho h of the stream is a n of >25%. |
| | placement of boulders or other large, natural obstruction is importa RE 20 19 18 17 16 | | 10 9 8 7 | 5 5 4 | 1 3 2 1 |
| 8. Bank Stability (score each bank) | Optimal Banks stable; evidence of eroston or bank failure absent or minimal; liftle potential for future problems. < 5% of bank affected. | Infrequent, small area | has areas of erosion poler | ich areas on; | Poor able; many eroded "raw" areas |
| SCORE RI SCORE LE | | 8 7 G 8 7 G | 5 4 3 5 4 3 | 2 1 | 0 0 |
| 9. Vegetative Protection (score eac bank) | Optimal h More than 90% of the stream bank surfaces | Şuboptimal 70-90% of stream banl surfaces covered by | Marginal c 50.70% of the strea bank surfaces cove | red stream | han 50% of the i bank surfaces |
| | and Immediate riparian zone covered by native vegetation; including frees, understory strubs, or non-woody macrophytes; vegetative disruption through grazing or moving minimal or not evident; allowed to grow naturally. | great extent; more than one-half of the potentia plant stubble helght remaining. | potential plant stuit | disrup or bank v high; v been re the or less | od by Vegetallon; llon of stream ggetafton is very egetaffon has moved to 5 cm In average I helght. |
| SCORE RB SCORE LB | 10 9 | A 7 6 | 5 4 3 5 4 3 | | 0 |
| . Riparian getative Zone Width core each bank) | Oplimal | Suboptimal Width of riparian zone 12-18 m; human activites | Marginal Width of riparian zone 6-12 m; human activit | Poor Width if eid <6 m; liti | ripatian zone lla or no |
| | roadbaeds, clear-culs, lawns, or crops) have notimpacted zone. | have impacted zone only minimally. | have impacted zone (great deal, | | vegetalion duo 1 activilles. |
| SCORE RB 1 | | 8 7 6 8 7 6 | 5 (1) 3 5 4 3 | 2 1 0 | |

| | 1199.01-BRFK4 | Ecoregion: | | | eet (front) Land Use | Mining |
|--|--|--|--|--|--|---------------|
| Fleld Team: | JEB, BWB | Survey Reason: | Bio Monitor | ם מני | Start Time: | TT:00 |
| Sfream Name: | Boaring Fork | Location: | Adjacent to trail rood | bank rd | Finish Time: | 止:35 |
| Date: Stream Physi | 9/4//2 icochemical | Latilude; 36 | | ongl(ude: | 82.72422 | |
| Instrument ID num Temperature: Dissolved Oxygen: | 8 8 Ca | Did In | 2.32 ictivity: 1363 strument pass all po - which parameter(s | | | f out = 0. |
| Method used (c | Dinvertebrate Collectice one) Sin Go (circle one) Go (circle one) Kif | gle Habllat (Ri od Margin | | Multi Hab None Vegetation | llat (Logs, plants, Area Sample | |
| Recent precipitation Stream flow (circl | (circle one) Ciou (circle one) Clear e one) Low AM WATERSHED RES: | Showers Normal LOCAL WATE | Rain/Snow Rain Aboye Norma RSHED FEATUREE counding Land Use: | Flood | her . | |
| Stream W Range of Average \ Discharge Est, Reach | Depth 3.5 ft Velocity ft/s | Surface Mining Deep Mining Oil Wells Hand Disposal | 6 6 9 | Construction Commercial Industrial Row Crops | Ø Forest Ø Pastúre/Grazi Ø Silvleuljúre Ø Urbañ Runof | |
| 0 Dams | Structures: Bridge Abutments | θ D | | ow ®Norma | Stream Type Perennial 0 | |
| Ø Other_ Riparian V Dominate* ® Trees Ø Grasses | Typo: Hatumoliv Shrubs Sycamore OHerbaceous Poplar | ⊕ 6 Fi ● Pa ⊕ Pa | opy Cover: olly Shaded (75-100%) utially Shaded (50-75% utially Exposed (25-50 | Channe 0 Dredg 6) 0 Chan | 0 Ephemeral I <u>Alterations;</u> sing nelization Partial) | 0 Seep |
| 0 Other Riparian V Dominate Trees | egetation: Donn. Treet Typo: Holumoliv Shrubs Sycamore Herbaceous Poplar strata B | Shrub Taxa Can O Fi O Pa O Pa | opy Cover: olly Shaded (75-100%) artially Shaded (50-75% | Channe 0 Dredg 6) 0 Chan | l Alterations; ging nelization | 0 Seep |
| € Other_ Riparian V Dominate* € Trees € Grasses Number of Substrate € Libstrate € Libstrate/Avallable | egetation: Donn Treet Type: Flowmon's Shribs Sycomore Herbaceous strata 3 DEst. OP.C. Doplor Optimal Greater then 70% of substrational for epifarina cotonization and fish covery mix of snags, submerged togs, undercut banks, cobbl or other stable habitat and a stage to allow full colonization potential fic. logs/snags the are not new fall and not transent).r | Shrub Taxa Can Pr Pr Pr Pr Pr Riffle 35 % High Gradien Suboptimal ale 40-70% mis of sie veil suited for full colonization poten adequate habitati maintenance of po it presence of addult on substrate in the for a fall, but not yet pre colination (may re end of scale). | opy Cover: opy Co | Channe 9 Dredge 6) 9 Channe %) (6Full 6 weet Inal its of stable abitat sbustrate clisturbed d. | Alterations: ging perization Partial) Poor Less (han 20% stathabitat, lack of habitation in the control of th | ole (at is |
| € Other_ Riparian V Dominate* € Trees € Grasses Number of Substrate € Libstrate (Avallable over SCORE | egetation: Donn Treet Type: Flatumoliv Shribs Sycamore Herbaceous Strata 3 DEst. OP.C. Doplar Optimal Greater then 70% of substration and fish covering to pifatum colonization and fish covering to 5 sags, submerged to 5, undercut banks, cobbit or other stable habitat and a stage to allow full colonization potential (i.e. logs/snags the po | Shrub Taxa Can Pr Pr Pr Pr Pr Riffle 35 % High Gradien Suboptimal ale 40-70% mis of sign of s | opy Cover: olly Shaded (75-100%) ontally Shaded (50-75%) ritally Exposed (25-50 lly Exposed (0-25%) Run t Habitat Data Sh ble habitat; 20-40% i habitat; avallability or habitat; frequently or temove pulations; frequently or temove pared for te at high 11 10 9 8 Margh rid Gravel, cob boulder par 75% surrou sediment. | Channe © Dredge (6) © Channe (6) Channe (6) % Leef Inal Jose than shustrate chalunbed d. 7 6 hal ble, and ticles are 50- nded by fine | l Alterations; Jing lelization Partial) Poor Less (han 20% stathabitat, lack of habitat, obvious; substrate | ole (at is |

| Vegetative Zone Width Width of riparian zone Width of riparian zone Width of riparian zone (score each bank) >18 m; human activities 12-18 m; human activities 6-12 m; human activited <6 m; little of no five impacted zone a riparian vegetation due roadbaeds, clear-cuts, only minimally. great deal, to human activities. | '4. Sediment Deposition S | Optimal Little or no enlarge of Islands or point and less than 5% for I; ow gradient streams) of the bot affected by sedime deposition. | bars bar formation, m f-20% from gravel, sand tine sediment. 5- tiom 50% for low-grad the bollom affect slight deposition pools. | ostly new gravel, sand l or sediment on old 10% (20- new bars; 30-50? lent) of 80% for low-grad ad; | d or fine material, increased bar development; more than 6,50-50% (80% for low- |
|--|--|--|--|---|--|
| Sintus Sintus | | | 16 15 14 13 12 | 11 10 9 8 7 | 6 5 4 3 2 1 |
| 6. Channel Alleration or dredging shasen to remain the control of dredging shasen to remain the control patter. Score: 20 19 18 17 16 September 16 September 17. Frequency of Riffles Optimal (or bends) Score: 20 19 18 17 16 September 16 September 16 September 17. Frequency of Riffles Optimal (or bends) Courrence of riffles relatively frequent fall for distance bitw. riffled shaded by width of the stream riffles are positively significant fall for the stream riffles are positively significant fall for the stream riffles are positively from the stream riffles are positively specially to the stream riffles are positively specially as the stream riffles are positively specially as the stream riffles are positively specially s | Status | Optimal Water reaches base both lower banks, a minimal amount of channel substrate is | nd water fills >75% o nd available channel; 25% of channel substrate is expos | f the Water fills 25-75% or available channel and/or riffle subst ed. are mostly expose | of the Very little water in channel and mostly rates present as slanding but, pools. |
| 7. Frequency of Riffles Corbinators Courrence of fiffles relatively frequent ratio of distance by riffled divided by width of this stream 714 feerefully 5 to 71; relegated of habitats if key, In stream without or other large, fautors obstruction is language placement of bipuleters or other large, fautors obstruction is language frequent, and fautors placement of bipuleters or other large, fautors obstruction is language placement of bipuleters or other large, fautors obstruction is language frequent, small areas of crosson or hank failure absent or minimal; liftle potential for future problems; 5% of bank affected, bank) SCORE 28 10 9 8 17 16 Suboptimal Moderately stable; Infrequent, small areas of crosson mostly or minimal; liftle potential for future problems; 5% of bank affected, bank) SCORE 18 10 9 SCORE 18 10 | 6. Channel Allera | tion Optimal Channelization or dredging absent or minimal; stream with normal patter. | Suboptimal Somo channelizatio present, usually in of bridge abutemen evidence of past channelization, i.e., dredging, (greater t past 20 yr.) may be present, but recent channelization is no | Marginal on Channelization ma areas extensive; embank nts; or shoring structu present on both ba and 40 - 80% of str reach channelized disrupted. | Poor y be Hanks shored with ments gablon or cement over res 80% of the stream reach nks; channelized and oam clistupted, instream and habitat greatly altered or |
| Courrence of riffles | | | | 1 10 9 8 7 6 | |
| SCORE 20 19 18 17 15 8. Bank Stability (score each bank) Suboptimal Banks stable; evidence of erosion or bank failure absent or milinimal; liftle potential for future problems. < 5% of bank affected. SCORE RB 10 9 SCORE LB 10 9 Vegetative Definal Protection (score each bank) Suboptimal Moderately stable; owner of erosion mostly, lietled over 5.50% of bank in reach has areas of erosion. SCORE RB 10 9 Vegetative Definal Protection (score each bank) Suboptimal Moderately stable; owner despite the factors of erosion mostly, lietled over 5.50% of bank in reach has areas of erosion; high erosion plential during floods. SCORE RB 10 9 Vegetative vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing malimal or not evident; almost all plants allowed to prow naturally. SCORE RB 10 9 SCORE RB 10 | | Occurrence of riffles relatively frequent ratt of distance buy, riffled divided by width of the stream <7;1 spenerally to 7); variety of habitat if key. In streams when riffles are continuous, placement of boulders or other large, natural | Occurrence of riffles o Infrequent; distance htw.riffles divided by the width of the streat 5 Is blw.74 o 15. | Occasional riffle or bend; boltom contot y proyide saome habit m distance btw. riffles divided by the width the stream is btw. 15 | Generally all flat water urs or shallow riffles; poor al; habitet; distance blw. riffles dividied by tho of width of the stream is a |
| 8. Baink S(ability (score each bank) Banks stable; evidence of croston or bank failure absent or minimal liftle potential for future problems. < SCORE RB 10 9 9. Vegetative Optimal Protection (score each More than 90% of the bank) **STORE RB 10 9 9. Vegetative Optimal Protection (score each More than 90% of the bank) **STORE RB 10 9 9. Vegetative Optimal Protection (score each More than 90% of the bank) **STORE RB 10 9 9. Vegetative Optimal Protection (score each More than 90% of the vegetation) including frees, understory shrubs, or non-woody macrophytes; vegetative yearing or moving minimal or not evident; almost all plants allowed to grow naturally. **SCORE RB 10 9 | SCO | | gas. | 0 10 9 8 7 6 | 5 4 3 2 1 |
| SCORE RB 10 9 9. Vegetative Optimal Protection (score each More than 90% of the bank) 9. Vegetative Optimal Protection (score each More than 90% of the bank) 9. Vegetative Optimal Protection (score each More than 90% of the bank) 8 7 6 5 4 3 2 1 0 9. Vegetative Optimal Subplimal Protection (score each More than 90% of the bank) 9. Vegetative Optimal Subplimal Protection (score each More than 90% of the stream bank surfaces covered by egetation; including trees, understory Shrubs, or non-woody macrophytes; vegetative disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. SCORE RB 10 9 SCORE RB 10 9 | 8. Bank Stability | Optimal Banks stable; eyidence of crosion or bank failure absent or minimal; liftle potential for future problems. < | Suboptimal Moderately stable; Infrequent, small areas of croslon mostly healed over 5-30% of bank in reach has area | Marginal Moderately unstable, 60% of bank in reach has areas of erosion; high erosion potential | Poor 30- Unstable; meny eroded areas "raw" areas |
| 9. Vegretative Optimal Protection (score each More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including frees, understory shrubs, or non-woody macrophytes; vegetative disruption of the potential plant subble height remaining or mowing milimat or not evident; allowed to grow naturally. SCORE RB 10 9 | | B 10 9 | 8 7 (G) | | 2 1 0 |
| Protection (score each More than 90% of the bank) stream bank surfaces and immediate riparian zone covered by fattive vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. SCORE RB 10 9 SCORE LB 1 | SCORE LI | | | | |
| SCORE RB 10 9 SGORE LB 10 9 B 7 6 Suboplimal Suboplimal Suboplimal Width of riparian zone (score each bank) 10. Riparian Optimal Suboplimal Width of riparian zone 12-18 m; human activities have impacted zone only minimally. I awns, or crops) have not impacted zone. Suboplimal Width of riparian zone 12-18 m; human activites have impacted zone only minimally. I awns, or crops) have not impacted zone. | Protection (score each bank) | h More than 90% of the stream bank surfaces and Immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more then one-half of the potential plant stubble height | 50.70% of the stream bank surfaces covered by vegetation; clistuption obvious; patches of bare soll or closely cropped vegetation common; less then one-half of the potential plant stubble | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 cm or less in average |
| 10. Riparian Optimal Suboptimal Marginal Poor Vegetative Zone Width of riparian zone Width of riparian zone Width of riparian zone (score each bank) >18 m; human activities 12-18 m; human activities 6-12 m; human activitied (i.ë, parking lots, roadbaeds, clear-cuts, lawns, or crops) have not impacted zone, not impacted zone. | | | | | |
| SCORE RB 10 (9) 8 7 6 5 4 3 2 4 6 | 10. Riparian /egetative Zone Width (score each bank) | Oplimal Width of riparian zone >18 in; human activities (i.e. parking lots, roadbaeds, clear-cuts, lawns, or crops) have | Suboplimal Width of riparian zone 12-18 m; human activites have impacted zone | Marginal Width of riparian zone 6-12 m; human activite id have impacted zone a | Poor Width if riparian zone <6 m; lillle or no riparian vegetation duo |
| | | | 7 6 | 5 4 3 | 2 1 0 2 1 0 SCORE |

132

| Station ID: | 1199.01-BCPT1 | Benthic Wacroinver Ecoregion: | tebrate Field Data S | | Minina |
|--|---|--|--|--|-----------|
| Fleld Team: | JEB, BWB | Survey Reason: Bio. | maniforing | Start Time: | :40 |
| Stream Name: | Cane Ratch | | below pond | | 5,25 |
| _{Date:} Stream Physi | 9/4/12 cochemical | Latitude; <u>36.955</u> | 84 Longliude: | 82.71094 | |
| Instrument ID num Temperature: Dissolved Oxygen: | 21. O Ga | Conductivity: Did instrumer | 7us/cm nt pass all post-calibration parameter(s) falled and a | checks? Y/Ø PH | 85.0<700 |
| Method used (c | Dinvertebrate Collectice one) Sin God Golden God God Golden God Golden God | gle Habital (Rille) od Marginal | Multi Ha Poor None Banks Vegelation | ibliat (Logs, planis, etc) Area Sampled | |
| Recent precipitation Stream flow (circle | (circle one) Glau | Showers I | Above Normal Floo | Other | |
| FEATUR Stream W Range of Average V Discharge Est. Reacl | tES: idth 12 ft Depth 2 ft Address | LOCAL WATERSHED Predominant Surrounding Surface Mining Deep Mining Oil Wells Hand Disposal | | ♥Forest Ø Pastûre/Grazing Ø Sifvicûlføre Ø Urbañ Rûnoff/S | |
| ⊕ Dams ⊕ Island ⊕ Other Riparian V Dominate | Type: Radionalic Shrubs Hamlock Herbaceous Buckeye | 9 High 9 Shrub Taxa Canopy Coy 9 Fully Shad Partially S 9 Partially E | Pooled 0 Low Norn Very Rapid or Torrential er: Char ted (75-100%) 0 Dre haded (50-75%) 0 Che xposed (25-50%) (6Ful | Stream Type: nal ©Perennial 0 Int 0 Ephemeral (ncl Afterations: adging annelization 1 0 Pertial) | |
| Substrate 6 | - Junio. | RIME_45% | Run_55% | Paol | _% |
| 1. Eplfáunál Súbstrafe/Avallable Cover | favorable for epifauna colonization and fish cover mix of snags, submerged logs, undercut banks, cobbi or other stable habitat and a | ade quate habitat for e maintenance of populations f presence of additional on substrate in the form of new | Marginal al; 20-40% mix of stable habilat; liabilat evallability less than destrable; spustrate frequently disturbed of removed. | Poor Less (han 20% stable habitat, lack of habitat obvious) substrate unstable or lacking. | is |
| 2. Embeddedness | Optimal Gravel, cobble, and houlder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Suboptimal Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment. | 10 9 8 7 6 Marginal Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment. | Foor Gravel, cobble, and boulder partites are more that 75% surrounded by fine sediment. | |
| SCORE 3. Vėlocily/Depth Regime | 20 19 18 17 16 Optimal CoverAll four velocity/depth regimes present (slow-deep, slow-shallow), fast-deep, fast-shallow), Slow is <0.3 m/s, deep is >0.5 | 15 14 13 12 11 Suboptimat Only 3 of the 4 regimes present (if fast shallow is missing, score lower than if missing other regimes). | 10 9 8 7 6 Marginal Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low). | 5 4 3 2 1 Poor Dominated by 1 veoletty/depth regime (usually slow-deep). | |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | |

| '4. Sediment Deposition S | Optimal Little or no enlarge of Islands or poin and less than 5% for I; ovy-gradient streams) of the bo affected by sedime deposition. CORE | t bars bar formation, mo (<20% from gravel, sand fine sediment, 5-3 ttom 50% for low-gradl | stly new gravel, sand or sediment oriold 0% (20- new bars; 30-50% ent) of 80% for low-gradl d; | or fine material, increased bar development; more than 50% (80% for low- |
|--|---|---|---|--|
| | 20 19 18 17 | 16 15 14 13 12 | 11 10 9 8 7 | 6 5 4 3 2 1 |
| 5, Channel Flow Status | m/s. Optimal Water reaches base both lower banks, a minimal amount of channel substrate i: exposed. | nd available channel; 25% of channel substrate is expose | or available channel, and/or tiffle substa ed. are mostly expose | channel and mostly ates present as standing |
| | CORE 20 19 18 17 1 | | | でんきょく かいこうし だんかまったき ちょうちょくき |
| 6. Channel Allera | tion Optimal Channelization or dredging absent or minimal; stream with normal patter, | Suboplimal Somo channelizatio present, usually in a of bridge abutemen evidence of past channelization, i.e., dredging, (greater if past 20 yr.) may be present, but recent channelization is not present. | reas extensive; embanki or shoring structur present on both bar and 40 - 80% of stro reach channelized a disrupted. | nents gablon or cement over es 80% of the stream reach iks; channelized and am disrupted, instream |
| SCO | ORE 20 19 18 17 16 | | 10 9 8 7 6 | 5 4 3 2 1 |
| 7. Frequency of Rif (or bends) | | Suboptimal Occurrence of riffles o Infrequent; distance bfw. riffles divided by the width of the strea blw. 7 to 15. | Margīnaļ Occasional rifile or bend; boļtom contou provide saome habitc | Poor Generally all flat water rs or shallow riffles; poor al; habitat; distance blw. riffles dividied by tho of the stream is a |
| SCO | RÉ 20 19 18 17 16 | 15 14 13 12 11 | 40 9 8 7 6 | 5 4 3 2 1 |
| 8. Bank Stability (score each bank) | Optimal Banks stable; evidence oferosion or bank failure absent or minimal; liftle potential for future problems. < 5% of bank affected. | Suboptimal Moderately stable; Infrequent, small areas of eroslon mostly healed over 5-30% of bank in reach has areas of eroslon. | has areas of erosion; high erosion potential | Poor 0- Unstable; many eroded areas "raw" areas |
| SCORER | | 8 7 G | 5) 4 3 | 2 1 0 |
| SCORE LE 9. Vegetative Protection (score eac | Optimal | 8 7 6 Suboptimal 70-90% of stream bank | 5 4 3 Marginal 50.70% of the stream | 2 1 0 Poor Less than 50% of the |
| bank) | stream bank surfaces and Immediate riparian zone covered by native vegetation; including frees, understory strubs, or non-woody macrophyles; vegetative disruption through grezing or moving minimal or not evident; almost all plants allowed to grow naturally. | surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant subble fielght remaining. | bank surfaces covered by vegetation; disruption obvious; patches of bare soll or closely cropped vegetation common; less then one-half of the potential plant slubble height remaining. | stream bank surfaces covered by Yegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 cm of less in average stubble helght. |
| SCORE RB | 10 9 | 8 ② 6 | 5 4 3 | 2 1 0 |
| SCORE LB | | 8 6 | 5 4 3 | 2 1 0 |
| Vegetative Zone Width (scoré each bank) | >18 m; human açliyitles (i.e. parking lots, | Suboptimal Width of riparian zone 12-18 m; human activites have impacted zone only minimally. | Marginal Width of riparian zone 6-12 m; homan activite id have impacted zone a great deal. | Poor Width If Iparian zone <6 m; Ilille or no riparian vegetation due to human activities. |
| SCORE RB SCORE LB | | | 5 4 3 5 4 3 | 2 1 0 2 1 0 SCORE |

APPENDIX B:

TABLES

Table 1. Quantitative listings of macroinvertebrates collected 04 September 2012 from six aquatic sample sites for surface mine permit number 1101760 in Wise County, Virginia.

| Order | Family | Fall 2012 | | | | | | |
|---------------|------------------|-----------|--------|--------|--------|--------|-------|--|
| | | BRFK-1 | BRFK-2 | BRFK-3 | BRFK-4 | BCPT-1 | BPR-1 | |
| Ephemeroptera | Baetidae | | | 2 | | 2 | 14 | |
| | Isonychiidae | | | | | | 3 | |
| Plecoptera | Chloroperlidae | | | | | 1 | | |
| | Leuctridae | | | | | 47 | 3 | |
| | Peltoperlidae | | | | | 1 | | |
| Trichoptera | Hydropsychidae | 100 | 84 | 51 | 64 | 39 | 70 | |
| | Philopotamidae | | | | | | 3 | |
| | Rhyacophilidae | | | | | | | |
| | Uenoidae | | | | | | | |
| Coleoptera | Elmidae | | 2 | | 2 | 6 | 2 | |
| | Psephenidae | | | | | 3 | | |
| Diptera | | | | 1 | | | | |
| | Chironomidae | 3 | 13 | 50 | 25 | 3 | 5 | |
| | Empididae | | | 2 | | | | |
| | Simuliidae | | | | 1 | 4 | 17 | |
| | Stratiomyidae | | 1 | | | | | |
| | Tipulidae | | | | | 1 | | |
| Odonata | Cordulegastridae | | | 1 | | | | |
| | Gomphidae | 2 | 1 | | | 1 | | |
| Megaloptera | Sialidae | | | | 2 | | | |
| Decapoda | Cambaridae | 1 | | | 1 | | | |
| Annelida | Oligochaeta | | 10 | 15 | 11 | | 2 | |
| | | 106 | 111 | 122 | 106 | 108 | 119 | |

Table 2. VSCI metrics calculated from the macroinvertebrates collected 04 September 2012 at six aquatic sample sites for surface mine permit number 1101760 in Wise County, Virginia

| Family Metrics | Fall 2012 | | | | | | |
|-----------------------|-----------|--------|--------|--------|--------|-------|--|
| Family Wetrics | BRFK-1 | BRFK-2 | BRFK-3 | BRFK-4 | BCPT-1 | BPR-1 | |
| Taxa Richness | 4 | 6 | 7 | 7 | 9 | 11 | |
| EPT Taxa | 1 | 1 | 2 | 1 | 5 | 5 | |
| % Ephemeroptera | 0 | 0 | 1.64 | 0 | 14.29 | 1.85 | |
| % PT - Hydropsychidae | 0 | 0 | 0 | 0 | 5 | 45.4 | |
| % Scrapers | 0 | 1.8 | 0 | 1.89 | 1.68 | 8.33 | |
| % Chironomidae | 2.83 | 11.71 | 40.98 | 23.58 | 4.2 | 2.78 | |
| % 2 Dominant | 97.17 | 87.39 | 82.79 | 83.96 | 73.11 | 79.63 | |
| нві | 5.9 | 5.95 | 5.93 | 5.91 | 5.39 | 3.03 | |
| VSCI | 23.61 | 25.74 | 24.54 | 25.55 | 41.19 | 55.16 | |

Table 3. Physiochemical water data collected 04 September 2012 at six aquatic sample sites for surface mine permit number 1101760 in Wise County, Virginia.

| Parameter | BRFK-1 | BRFK-2 | BRFK-3 | BRFK-4 | BCPT-1 | BPR-1 |
|---------------------------|--------|--------|--------|--------|--------|-------|
| Temperature (Celsius) | 18.1 | 20 | 19.3 | 18.8 | 21 | 18.5 |
| Specific Conductance (µs) | 1338 | 1388 | 1366 | 1368 | 959 | 1140 |
| рН | *8.25 | *8.4 | *8.45 | *8.33 | *8.27 | *8.29 |
| Dissolved Oxygen mg/l) | 9.1 | 8.9 | 8.88 | 8.97 | 8.47 | 8.47 |

^{* =} Failed post calibration test

APPENDIX C:

GRAB SAMPLE ANALYSIS